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EXPERIMENTAL PSYCHOLOGY AT WELLESLEY COLLEGE.

MARY WHITON CALKINS.

After the discussion of the relative merits of experimental as compared with merely introspective psychology, a practical question suggests itself concerning the introduction of experimental psychology into the regular college curriculum. This is a complicated problem of expediency, the question of the equipment of the laboratory, of the relative amount of laboratory work, of the proper direction of students' experiments. Such questions are especially prominent in cases in which psychology is a required subject, and in which our course is a general one and must be adapted to students without especial scientific training or without particular interest in experimental work. In such a course, it is sometimes urged, the introduction of experimental methods burdens the general student with details valuable only to the specialist, substitutes technical minutiae for psychological principle and tends to confuse psychology with the other sciences.

This paper is an attempt to meet difficulties of this sort by the record of a year's experience with a general course in psychology, making extensive use of experimental methods. In the fall of 1892 a course in "Psychology, including Experimental Psychology," was offered at Wellesley College as one of the alternative senior requirements in psychology. The course was taken by fifty-four students, of whom all but one or two had had no previous training in the subject. All of these had taken a year's course, including laboratory work, in chemistry, and only three had failed to follow a similar course in physics. Most had no training in physiology, and many of them had a more or less pronounced distaste for laboratory work. The aim throughout was to supplement, and in no sense to supersede, introspection; to lead students to observe in detail and to verify facts of their ordinary experience; to familiarize them with the results of modern investigation and with the usual experimental methods, and to introduce them to the important works of psychological literature.

The first month was devoted to a study of cerebral physiology. Ladd's "Elements of Psychology" was used in this early part of the course as a text-book. The class work included recitations, informal lectures and some written work on the part of the students. One of these papers, for example, required an enumeration, accompanying a rough diagram, of the parts of the human brain, as developed from the dorsal and ventral sides respectively of the three "primary bulbs." The study of the brain by text-book, by plates, and especially by models, preceded the dissection by each student of a lamb's brain. The brains had been preserved according to Dr. James's directions.¹ (Wide-mouthed candy jars, fitted with rubbers to prevent evaporation, proved an inexpensive substitute for the regular Whitehall and Taitum jars.) The dissection was under

¹ Since published in the *Briefer Course in Psychology*, pp. 81-90.

the general direction of the instructor. The students were provided with simple directions and were required to identify the most important parts of the brain. The results of this work were very satisfactory. The students, even those who had dreaded the dissection, were practically unanimous in regard to its value, as clearing up the difficult points in cerebral anatomy. In the class room, during this week, in which the dissection was going on, the principal theories of cerebral localization were discussed.

The next six weeks were spent in experimental study of sensation. About seventy experiments were performed by the students on sensations of contact, of pressure, of temperature, of taste, of hearing and of sight. The experiments, almost without exception, were selected from those suggested by Dr. E. C. Sanford in his "Laboratory Course in Psychology," but re-arranged with reference to the plan of the lectures and of the class discussion. Papyrographed descriptions of the experiments were distributed to the students and commented on in class before the experiments were undertaken. The instructor kept daily laboratory hours in order to answer questions and to offer assistance. Each student was responsible for the record of her own experiments.

In class, reports were made on the results of experiments, and recitations were conducted on the physiology of the different senses. The bearing of the different experiments on the theory of perception was carefully discussed. Special effort was made to free the word "sensation" from the vague, dualistic meaning which it often carries with it; sensation was treated as essentially "the first thing in the way of consciousness." The three theories of perception, Associationist, Intellectualist and Physiological-psychological, were carefully studied, and in this connection parts of Dr. James's chapters on "The Mind-Stuff Theory," "Sensations" and "Perception" were assigned for reading. Of course, in so elementary a course no new experimental results were gained. All the more important experiments usually performed were repeated. The taste experiments were so unpopular that I should never repeat them in a general class of students who are not specializing in the subject. I should also omit most experiments involving exact measurement. For instance, I should do no more than familiarize the class with the use of the Galton bar and of the perimeter.

Some of the students were genuinely interested in the experiments, carried them further than required and made independent observations; a large number, on the other hand, performed them conscientiously, but without especial enthusiasm; some cordially detested them from beginning to end; but almost all recognized their value as a stimulus to observation and as a basis for psychological theory.

The following questions, asked at an informal, forty-five minute examination, suggest the character of the experimental work:—

I. Describe fully the following experiments. State the theories on which they bear and the conclusions which you draw from them:—

a. The "colored shadows" experiment.

b. Scheiner's experiment.

II. What are the dermal senses?

III. What is the (so-called) joint sense? Describe an experiment proving its existence.

In the study of association, the old distinction between association "by contiguity" and that "by similarity" was replaced by one between "desistent association," in which no part of the earlier

¹ American Journal of Psychology.

object of consciousness persists in consciousness, and "persistent association," in which all or part of it persists.¹ Dr. James's quantitative distinctions, corresponding with the terms "total," "partial" and "focalized," were also made. Students were referred to Hobbes, to Hartley, to Bain and to Dr. James, and were required to illustrate, by original examples or by quotation, the different sorts of association. This work proved very interesting and was valuable in co-ordinating psychological with literary study. The experimental work accompanying this study illustrated the value of association in shortening intellectual processes, and consisted simply in comparing the slower reading of one hundred unconnected monosyllables with the reading of one hundred connected words. Reading of passages of one hundred words in different languages was also carefully timed and compared.

A more extended experiment in association was later carried out. Each student wrote a list of thirty words, so associated that each suggested the next. The starting point was the word "book," suggested in writing, but not read until the time of the experiment. Each list was studied by its writer, who marked with a V the names of objects or events which were visualized; indicated with a C those connected with childhood life; classified the association, as desistent or as persistent (of quality or of object); and indicated, in each case, the so-called secondary law of the association (recency, frequency or vividness). Of course each list was written when the subject was alone and undisturbed.

The fifty papers thus prepared were carefully studied by one student as the foundation of her final essay. She compared with them similar ones obtained from two classes of school children of varying ages, and from a few people in middle life. Her results are interesting. One-half the objects or scenes (in the college lists, which were the only ones indicating this fact) were visualized. Only one-fifteenth related to childhood—suggesting that the predominance of Mr. Galton's childhood associations² is not universal. The lack of them may be due to the youth of the experimenters. A comparison of the lists shows that in the children's lists, recency is the most frequent explanation of suggestiveness, while in the college lists the vividness of the earlier object of consciousness is of greatest importance. The result tallies with the fact that "children's interests are more of yesterday and today."

The subject of attention was discussed on the basis of Dr. James's admirable chapter. The experimental work was in divided attention, the performance and accurate timing of two intellectual processes, first separately and then in combination.

A brief study of consciousness in its "identifying" and "discriminating" aspects was followed by a six-weeks' study of space-perception. Lectures were offered on the three chief theories, the Empiricist, the Nativist-Kantian and the Nativist-Sensational. The required reading included references to Berkeley, to Mill, to Spencer, to D. A. Spalding (MacMillan, February, 1873), to Preyer (Appendix C of Vol. II., *The Mind of The Child*), to James (parts of the Space-Chapter), to Kant (*Æsthetic*, "Metaphysical Deduction").

The experiments, of which there were more than thirty, illustrated the methods of gaining, or at least of developing, the space-consciousness. The theories of single vision were carefully studied and were illustrated by diagrams and by "Cyclopean eye" experi-

¹ Cf. an article in the *Philosophical Review*, July, 1892.

² *Inquiries into Human Faculty*, pp. 191-203.

ments. The study of the perception of depth included an adaptation from Hering's experiment, in which the subject, looking through a tube, finds that he can correctly distinguish, within very small distances, whether a shot is dropped before or behind a black string, stretched before a white background. The fact and the laws of convergence were studied with the aid of a Wheatstone stereoscope.

There followed a consideration of illusions of space; and of Unvisual space, including the experiments suggested by Dr. James on so-called tympanum spatial-sensations, and others, with a telegraph-snapper, on the location of sounds. The scope of the work is suggested by the following outline for a paper required at the close of the work, and written without consultation of books or of notes.

SPACE.—Review Subjects.

(NOTE: Support all statements by description of experiments bearing on the question.)

I. Theories of Single Vision.

a. Identical Point Theory.

1. Statement.
2. Limitations.

b. Physiological Association Theory.

1. Statement.
2. Relation to *a*.

II. The Third Dimension.

- a. 1. The Nativistic Position (in every form).
2. "Empiristic" " " " "

b. How do we gain (or at least develop) the consciousness of the third dimension?

(NOTE: Include reference to the questions: Can we perceive depth without motion of the eyeballs? If so, what are the means of perceiving depth in the given case?)

III. The Value of the Empiristic Theory to the Nativist.

In the study of memory and of the imagination, the only experiments were a few on "The Mental Span." Students were referred to James, to Burnham, to Lewes, to Ruskin and to Everett. Par- amnesia was of course discussed.

Abnormal psychology received, throughout the course, comparatively little attention, because it seemed so evident that a careful study of the facts of normal consciousness must precede any scholarly consideration of the abnormal; because, also, there seemed special need of combating the popular notion which apparently regards psychology as a synonym for hypnotism and telepathy. The abnormal was therefore treated throughout from the point of view of the ordinary consciousness and its phenomena were discussed as exaggerated manifestations of the phases of all consciousness. The subject was naturally introduced by a study of dreams; hypnotism was the only other topic considered.

The study of the emotions and of the will was accompanied by no experimental work. Chapters of Höffding, of James, of Mill, of Spencer and of Darwin formed the required reading; James's theory of the emotions was discussed; a classification of the feelings, adapted from Mercier¹, but rejecting his physiological principle of division, was the starting-point of a somewhat practical discussion.

The last week of the course was occupied with reaction-time experiments, which had been postponed to this time, only through necessary delay in procuring the apparatus; the work should properly have been scattered through the year. There was time for

¹Mind, Vol. IX.

little more than an illustration of method and an approximate verification of the more important results in reactions to sound and in more complicated reactions, involving association, discrimination and choice. Averages of simple reaction-times, with and then without signal, showing a general increase in the time of the latter, were made by several students and included in essays on attention. Students were required to read Jastrow's "Time-Relations of Mental Phenomena."

The study of volition led to several days' discussion of the problems of determinism and indeterminism. This was undertaken with the express remark that the subject is metaphysical and not psychological. The favorable result of this study confirms my opinion of the value of an occasional consideration of so-called metaphysical problems in a general course of psychology, with students who are neither studying philosophy nor specializing in psychology. To repress the philosophical questions, suggested by a study of psychological phenomena, is difficult; to consider them is harmful, only if the distinction between metaphysics and psychology is not sharply made; to discuss them may be of great pedagogical value. One may agree with Dr. James that "metaphysics fragmentary, irresponsible, and half-awake, and unconscious that she is metaphysical, spoils two good things when she injects herself into a natural science," but one may still believe that a course which properly is called psychology, because of the immense preponderance of psychological discussion and investigation, may yet make an occasional metaphysical digression. Such a plan at least avoids the difficulty which may be raised in the cases in which the course is a required one in the philosophical department—the objection that psychology, as a mere science among sciences, does not merit this pre-eminence.

In place of a final examination, a psychological essay was required. The subjects assigned were very general and were intended as subjects for study rather than as definite essay-headings. The immediate topic of the paper was to be decided after the study and not before. Such subjects as "Association," "Attention," "Memory," "Imagination," "The Psychology of Language," "The Psychology of Childhood," "The Psychology of Blindness," "Aphasia," "Animal Psychology," were chosen in this way. Writers on the first two subjects worked up the statistics, to which allusion has already been made. The specialization of topics, within the broad field indicated, showed itself in various ways. One student studied the prevalence among imaginative people of a "continued story," never written, seldom mentioned, but very significant, especially in the emotional life. Of fifty-four students who were questioned, nineteen have had such a story, whose characters grow, but retain a constant identity; whose situations change, but only in accordance with the plot, usually a simple one, of the story. With all the story began in childhood; with eight it still continues, but in all cases the interests of adult life have somewhat overshadowed it. A comparison was made with the experiences of thirty-six young men, students in Iowa College, with the result that only three testify to the possession, at any time, of a continued story.

The study of the psychology of blindness was accompanied by visits to the Perkins Institute. A student who writes on "The Imagination of the Blind," bases her conclusions on a personal study of twenty-five blind children. She questioned the children, consulted with their teachers, and read their compositions. Those who write on the psychology of childhood have made personal observations on babies and little children. One writes on "The

Senses of the Child," the other on "The Memory and Imagination of Children." Both papers contain fresh material.

No topics in abnormal psychology were originally included, but several students especially interested in the subject write on "Hypnotism," "Dreams," "Illusions." Most of these kept written records of their dreams, during two months. Some interesting observations were made. One dreamer was able to reproduce, in a series of drawings, certain figures of a dream; several well-marked instances of reasoning are noted; one writer makes the discovery that "my dreams are forgotten immediately upon waking, but that the instant I touch my head to the pillow the following night, the dreams of the preceding night come back with great clearness. In keeping a record, I was often obliged to wait until the following night to record something I had dreamed early in the morning." The analogy with the hypnotic memory is very interesting.¹

In connection with the work of the course, a collection of statistics about colored hearing and number-forms was undertaken. Five hundred and forty-three persons, of whom five hundred and twenty-six were members of Wellesley College, were questioned. The general results are the following: Ninety-eight are affected in one or both of these ways; thirty-two have colored hearing, and seventy-eight have forms for numbers, for months, for days (or for all); fourteen have both colored hearing and some "form." These facts were gained by students, aided by a simple set of questions; in the cases of colored hearing, results were verified by questioning the subjects a second time after the lapse of two months; the number-form was in each case drawn by the subject; in all cases, records have been kept in uniform shape. Five essays were written on the basis of these statistics, of which each makes a special study of one or two cases of particular interest; from these essays I make occasional extracts in my brief report of our results.

Among the thirty-three cases of colored hearing are nineteen in which proper names of people suggest a color; nine instances of musical association; twelve cases in which names of days or of months are associated with color, and four of colored number-association, of which one is a colored number form. In seventeen cases letters suggest colors, usually by their sound, but sometimes by their appearance, and in three of these lists, the whole alphabet is included.

Galton's assertion that vowels more commonly than consonants suggest colors, is not confirmed by our results; among seventeen letter-associations, there are ten in which both consonants and vowels are suggestive; four in which consonants only are associated with color; and but three in which only vowel-associations occur.

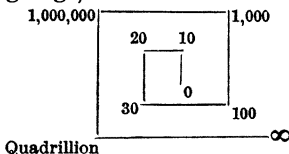
The manner of the word-coloring cannot be reduced to any general formulæ. It follows sometimes the color of the initial letter, sometimes that of a repeated letter. Sometimes, again, its color is that of the mixture of the colors of the different letters. In one case, "0 by itself is gray; when occurring with other numbers it takes the color of the color of the accompanying number. Thus 80 is blue, the color of 8."

Like most observers, we have found that *o* and *i* correspond respectively with white and black—and this is almost certainly

¹Cf. Ribot, *Diseases of Personality*, p. 118 (I know no other reference to this phenomenon).

through association with the appearance of the letter. The only positive exception which we find¹ in which *i* is red, falls in with the more indefinite generalization of MM. Beaumis and Binet², that either *i* or *a* is black, white or red. We find also the following instances of apparent uniformity: In six cases out of twelve, *a* is blue; in five out of twelve, *e* is yellow, and in six out of thirteen, *s* is yellow. This last is the only instance of uniformity among consonant-associations.

Our recorded number-forms, of which there are forty-eight, are of most varied sorts, including single and parallel lines; lines horizontal and vertical; zig-zags, curves and one Greek border,



One subject has "two forms, one for positive numbers to infinity, and another (extending in both directions from 0) including negatives, infinitesimals and fractions."

Not all changes of direction are at 12 or at 10. "Out of twenty-four, in which the lines are continuous,

Seven	turn	at	10
Six	"	"	12
Five	"	"	20
Five	"	"	6"

About two-thirds turn toward the right. Several forms are in tri-dimensional space, and we have one elaborate description of a form stretching away from the subject, in which the more prominent numbers stand out like mountain-peaks and hide the intervening ones.

Our records include several cases of pronounced emotional association combined with a sort of dramatization of numbers or of colors. Thus, one subject writes, "1, 2, 4, 7 and 8 are reliable, quiet, well-disposed, but not brilliant numbers; 3 is a sharp, shrewd, noisy and disagreeable number, always making as much trouble as possible. For 13 I always had a great antipathy. It had all the disagreeable qualities of 3 added to a pertness and aggressiveness which made it repugnant to all the other numbers, with which it seemed never to associate. I never wanted to be thirteen years old."

The circle is the most constant of the month-forms (occurring in eighteen out of fifty cases). Its plane is in most cases parallel, in one perpendicular, to the plane of the earth. In the forms for the days of the week, Sunday almost always occupies a conspicuous position. "When the plane changes, this day is higher than the rest, so that in passing from Saturday to Sunday, a step up is made." To one person "the first three days of the week seem much greater than the last three. In vacation, I always plan to make visits, receive company on the first three days of the week; the other three seem crowded together and insignificant."

No new explanations of the phenomena were offered or discussed. Only one affirmative answer, among twenty in the negative, was received to the question: "Can you compare your form with any

¹There is, besides, one case in which *i* is grey.

²Revue Philosophique, April, 1892.

pattern of wall-paper or carpet, with any crack in the plastering or with any other line which you might have seen when learning the numbers in childhood?"

So far, then, as our results support any theory, they tend toward one that is physiological; at least, they oppose, especially with reference to colored hearing, the explanations through any other than forgotten and fundamental childhood associations.